

NUC K250 Reactor Theory

Required Elective

Catalog Description: This course studies nuclear energy with emphasis on fission, reactor types, moderation of neutrons, activation and decay schemes, transmutations, neutron diffusion theory, and theoretical reactor operation including heat transfer, power transients, instrumentation and resultant radiation.

Prerequisites: MAT K254, NUC K110/111, NUC K117, NUC K118, PHY K114, PHY K115

Textbook(s) or other materials: Basic Nuclear Engineering, Foster and Wright, 4th edition; Nuclear Reactor Engineering, Glasstone and Sesonski, 3rd edition

Course learning outcomes/Expected performance criteria:

The course provides a study of reactor physics; from an introduction to basic concepts, nuclear reactions, fission and fusion mechanisms, radioisotopes and neutron interactions; to the study of reactor criticality with emphasis on neutron diffusion theory, theoretical reactor operation including heat generation and heat transfer, power transients, instrumentation and resultant radiation.

Topics covered:

	COURSE TOPICS/CONTENT	HOURS
1.	<u>NUCLEAR REACTIONS</u> Types of Radiation and Interactions Cross Section Flux and Interaction Rate Slowing Down of Neutrons	10
2.	<u>NUCLEAR FISSION AND FUSION</u> Mechanism Products	5
3.	<u>RADIATION DETECTION</u> Ionization in an Electric Field Types of Detectors	5
4.	<u>HEALTH PHYSICS</u> Overview	2
5.	<u>RADIOISOTOPES</u> Overview	2
6.	<u>NEUTRON INTERACTIONS</u> Cross Section Attenuation Mean Free Path Distribution and Flux	8
7.	<u>STEADY-STATE REACTOR</u> Infinite Multiplication Factor Effective Multiplication Factor Neutron Current Density Diffusion Equation Reactor Core Shapes Reflection Reactor Cores Two Group Method Group Method Comparison Fast Reactors Multigroup Techniques	16
8.	<u>TRANSIENT REACTOR BEHAVIOR AND CONTROL</u>	16

	Neutron Lifetime	
	Reactivity	
	Delayed Neutrons	
	Diffusion Equation	
	Temperature Effects	
	Fission Products	
	Poisons	
	Fuel Depletion	
	Reactor Control	
	Doppler Effect	
	Reactivity Variances	
9.	<u>RADIATION DAMAGE</u>	2
	Overview	
10.	<u>NUCLEAR HEAT TRANSFER</u>	6
	Fuel Elements	
	Cooling Channels	
	Boiling	
	Super Heat	
	Liquid Metals	
11.	<u>FUEL CYCLE TECHNOLOGY</u>	4
	Accident Analysis	
	Risk Assessment	
	Radioactive Wastes	
	TOTAL HOURS	60

Class/Lab schedule: 3 lecture sessions each week

Relationship of course to Criterion 5 and Program Outcomes:

All students are required to maintain an online learning portfolio in Digication that uses the college template. Through this electronic tool students will have the opportunity to monitor their own growth in college-wide learning. The student will keep his/her learning portfolio and may continue to use the Digication account after graduation. A Three Rivers General Education Assessment Team will select and review random works to improve the college experience for all. Student work reviewed for assessment purposes will not include names and all student work will remain private and anonymous for college improvement purposes. Students will have the ability to integrate learning from the classroom, college, and life in general, which will provide additional learning opportunities. If desired, students will have the option to create multiple portfolios.

Prepared by: James R. Sherrard

Date: Fall 2014